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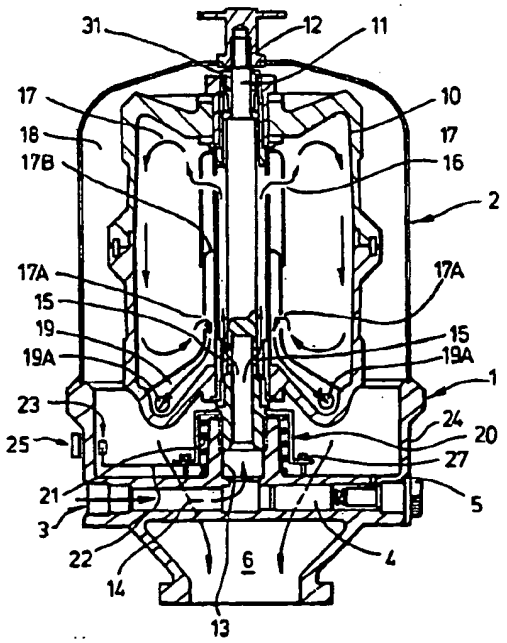

(57) Abstract

A centrifugal cleaner for fluids such as oil includes means (23, 25) for determining the weight of accumulated detritus in the rotor (10), by detecting the degree to which the latter compresses a spring (21) when at rest and substantially emptied of fluid.

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Improved filters

This invention relates to liquid filtration and is in particular concerned with centrifugal cleaners for use inter alia, in the lubricant oil circulation systems of internal combustion engines.

Centrifugal cleaners are well-known; they include a centrifuge member or rotor which is driven by the oil flow itself, the oil being constrained to flow through nozzles in the form of orifices directed generally tangentially with respect to the axis of rotation of the rotor. The rotor itself is freely rotatable on a supporting spindle; it is conventional for the geometry of the interface between the spindle and the rotor to be arranged such that on rotation, the rotor rises from its at rest position, until its upper end is in running contact with a simple thrust bearing. Typically, rotational speeds of 4-8000 rpm are achieved.

Dirt and/or metallic particles are thrown radially outwardly by the rotating action of the rotor and form a cake on the inside of the latter. Periodically the assembly is stripped down to allow removal of the cake, although in a conventional centrifugal cleaner the exact extent of the accumulation is not known until it is dismantled.

It is an object of the present invention to provide a centrifugal cleaner in which the extent of accumulation of detritus can be at least approximately established without opening the casing.

According to the present invention, a centrifugal cleaner comprises a casing having a fluid inlet and a fluid outlet with an axially displaceable centrifuge rotor interposed therebetween, the cleaner further including support means for said rotor when at rest, spring means for biassing said support means towards a first position corresponding to the at rest position of the rotor when empty of fluid and detritus, together with switch means for indicating when the rotor is displaced a pre-chosen distance relative to said first position, said distance corresponding to a given mass of detritus in the rotor when at rest and with substantially all the fluid drained therefrom.

The invention thus provides a means of determining a

specific change in the weight of the rotor due to the accumulation of detritus.

The means for sensing the position of the rotor may take the form of a magnet associated with the support means and a sensor, for example of the Hall-effect type, mounted externally or internally of the casing. The spring is preferably of controlled compression characteristics so that the extent to which it is compressed will reflect (any increase in) the weight of the rotor when at rest on the support means. The casing is preferably oriented in use so that the axis of rotation of the rotor is in a sensibly vertical plane, the spring means serving to bias the support means upwards against gravity. The exact vertical position of the support means when the rotor is at rest and with substantially all the fluid drained therefrom at any time depends on the total mass of the rotor, which comprises the empty rotor mass plus the mass of any accumulated detritus entrapped within it.

According to one embodiment of the invention, it is preferred to simply detect a predetermined detritus weight corresponding to a "rotor full" condition. In such a case, a normally open switch may be used, closure of the switch indicating that a particular weight has been reached. It is only necessary to briefly interrupt the fluid flow, allow the rotor to drain and then check if the switch means has been actuated. However, if desired, a

plurality of switches may be used, each corresponding to a different pre-chosen mass of detritus in the at rest, substantially fluid free rotor.

In use, the cleaner is run for a specified period of, for example, 6, 12, 24 or 48 hours and the oil supply is interrupted. After a suitable interval to allow oil to drain and the rotor to reach a complete standstill, the position of the rotor relative to its known, empty position is determined by the sensing means. Preferably the rotor is provided with a one-way valve to allow air to enter the rotor to accelerate drainage. Because a switch is used the indication will be of the "go" or "no go" variety; the rotor will either be full or not. A decision on replacement/overhaul of the cleaner can then be taken. Other types of switch means may be employed of course without departing from the scope of this invention. If more than one such means is provided, indications such as half full can be obtained.

In order that the invention be better understood, two preferred embodiments of it will now be described by way of example with reference to the accompanying drawings in which Figure 1 is a schematic cross-sectional side view of a cleaner in accordance with the invention, and Figure 2 is a similar view of another cleaner in accordance with the invention. For convenience, like parts in both Figures bear the same reference numerals.

In both Figures, the cleaner has a base casting 1 and a cover 2. The base casting has a fluid (oil) inlet 3, a cut-off valve shuttle 4 and a cut-off valve plug 5. The base casting also has an outlet orifice 6.

A centrifuge rotor 10 is freely rotatably mounted inside the cover on a spindle 11, the upper end of which is located in the radial direction by a recess inside a bush 12 extending outwardly of the cover 2. The upper end of the rotor is provided with a thrust bearing 31. The lower end of the spindle 11 is screw threaded into a correspondingly threaded hole inside a boss 13 which projects from and is part of the base casting. This lower part of the spindle 11 contains a fluid entry passage 14 which extends up into the rotor, the inside of which receives fluid via cross drillings 15 in the spindle. The rotor itself contains an internal sleeve 16 around the spindle 11, fluid from the latter flowing up until it reaches ports 17 which allow it to enter the upper region of the rotor. After being centrifuged in the rotor, the fluid escapes into the sleeve 16 through orifices 17A located below an internal baffle 17B. From the orifices 17A the oil flows downwardly into the base area 19, from which it escapes into the casing 18 and thence to the outlet 6 via a pair of tangentially directed nozzles, (not shown in detail, but whose location is indicated at 19A). The operation of the device is entirely conventional in that fluid passing through it is subjected to a

combination of centrifugal force and sharp changes in direction before it finally escapes to the inside 18 of the cover and thence to the outlet 6. Relatively heavy detritus build up as a cake on the wall of the rotor. Below the rotor there is an axially displaceable support member 20. Beneath the support member there is a helical spring 21, one end of which seats against the base casting 1 and the opposite end of which biasses the support member upwards to engage the lower regions of the rotor when the latter drops to its at rest position. Attached to the support member is an arm 22 carrying a magnet 23, the latter being located close to the side wall 24 of the base casting 1. On the outer surface of the side wall 24 there is a Hall-effect sensor 25 which is connected to a control panel (not shown) by a cable 26.

It should be noted that although the support member is free to move to a limited extent in the axial direction, it is constrained in a radial direction by fastening screws 27. These prevent rotation of the arm/magnet relative to the sensor 25.

The spring 21 is calibrated so that its degree of axial compression corresponds to a known rotor weight including the weight of detritus trapped in the rotor. For example, by appropriate selection of the spring, a 5 mm compression may correspond to 5 kg of detritus in the rotor. By periodically shutting off the fluid supply, allowing a

standard time for fluid drainage and the interrogating the sensor 25, it is possible to check if detritus build up has reached a prec-chosen amount without removing the cover and dismantling the rotor. This routine lends itself to automation since it is possible to programme the control panel to shut off the fluid supply by means of a solenoid valve, wait a prechosen time for drainage to finish and then check the amount of detritus. The amount may be displayed by means of "go" and "no go" lamps colour coded to indicate at a glance the current status of the cleaner.

Figure 2 is identical to figure 1 except for the use of a simple switch 30 to detect when the total mass exceeds a pre-chosen limit corresponding to a "cleaner full" condition. The switch 30 may be an electrical contact or it may be for example a microswitch. The arm 22 is of reduced length; the magnet 23, and the sensor 25 are not necessary in this case.

Obviously there are many ways of implementing such a system in practice without departing from the scope of this invention; other types of sensor device may be used according to the degree of complexity/accuracy required. In particular, the invention lends itself to a high degree of automation, since the control and monitoring functions can be regulated by conventional electrical timing arrangements.

CLAIMS

1. A centrifugal cleaner comprising a casing having a fluid inlet and a fluid outlet with an axially displaceable centrifuge rotor interposed therebetween, the cleaner further including support means for the rotor when at rest, spring means for biassing said support means towards a first position corresponding to the at rest position of the rotor when empty of fluid and detritus, together with switch means for sensing the position of the support means relative to said first position when the rotor is axially displaced a pre-chosen distance relative to said first position, said distance corresponding to a given mass of detritus in the rotor when at rest and substantially all the fluid has been drained therefrom.

2. A cleaner according to claim 1 wherein the switch means for sensing the position of the support means is constituted by a magnet associated with the support means and a sensor device mounted inwardly or outwardly of the casing.

3. A cleaner according to claim 2 wherein the magnet is mounted on an arm projecting from said support member towards the inner surface of the casing.

4. A cleaner according to claim 2 wherein the sensor is a Hall-effect device.

5. A cleaner according to any of claims 1-4, wherein the spring means is constituted by a helical spring, the support member being displaceable under the influence of the spring along the axis of rotation of the rotor to receive the same when at rest.

6. A cleaner according to claim 1 wherein the switch means for sensing the position of the support means is constituted by a switch operable by the support means when the latter is displaced a pre-chosen amount corresponding to a given mass of detritus in the rotor.

7. A cleaner according the claim 1 including a plurality of switch means, each of which is arranged to sense a different pre-chosen mass of detritus in the rotor when at rest and substantially all the fluid has drained therefrom.

8. A cleaner according to any of claims 1-6 wherein the support member is constrained to move only axially with respect to the rotor.

9. A cleaner according to any preceding claim including means whereby the rotor can be drained of fluid when at rest on the support means.

10. A centrifugal cleaner substantially as herein described with reference to and as illustrated by the accompanying drawings.

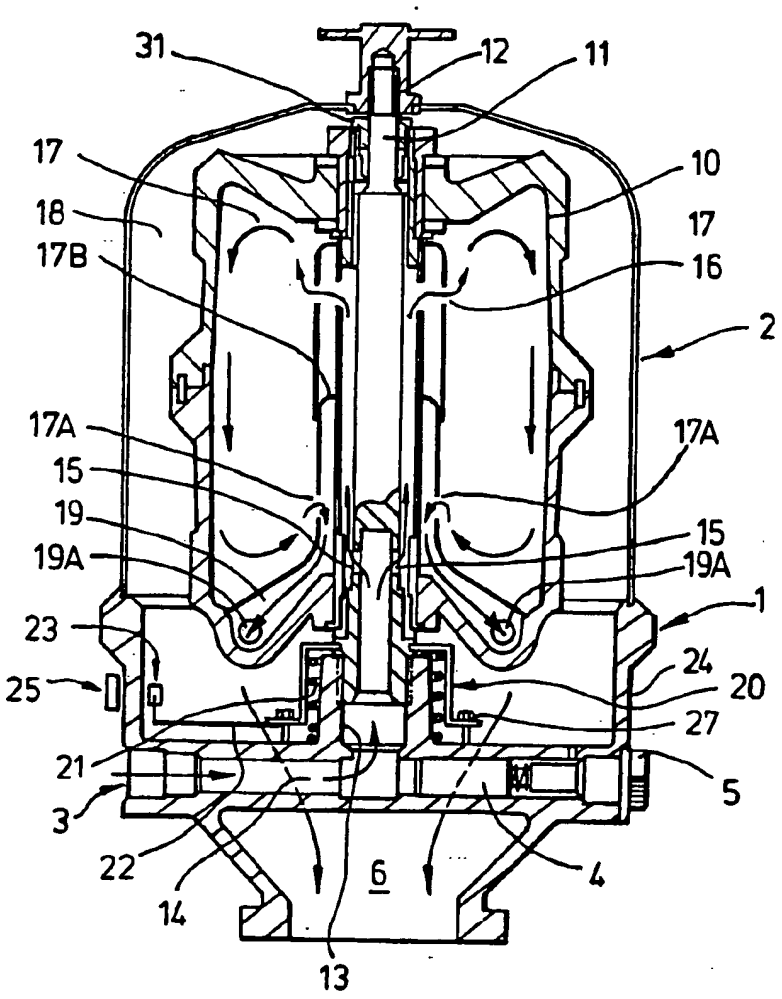
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FIG.1

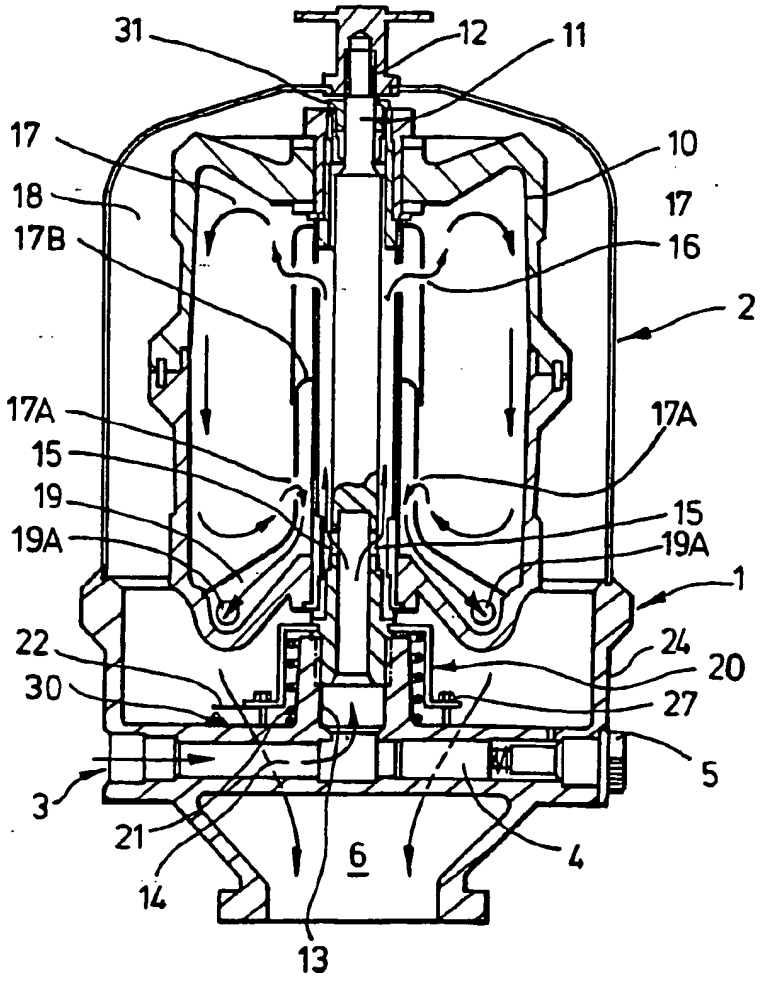
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FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/00431

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B04B9/06

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	B04B ; F16N ; F01M

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[10]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	US,A,4 221 323 (L.B. COURTOT) 9 September 1980	1,2,5,6
A	see the whole document	8

Y	PATENT ABSTRACTS OF JAPAN vol. 6, no. 154 (C-119)(1032) 14 August 1982 & JP,A,57 075 164 (TOKYO SHIBAURA DENKI K.K.) 11 May 1982	1,2,5
A	see abstract	8

Y	GB,A,2 181 675 (U.K. ATOMIC ENERGY AUTHORITY) 29 April 1987	1,2,5
A	see the whole document	8

Y	DE,A,1 101 295 (SIEMENS-SCHUCKERTWERKE A.G.) 2 March 1961	1,2,5
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
04 JUNE 1992	30.06.92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	VERDONCK J.C.M.J.

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Category*	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	DE,A,1 007 701 (SIEMENS-SCHUCKERTWERKE A.G.) 2 May 1957	1,6
A	see the whole document	3
A	SOVIET INVENTIONS ILLUSTRATED Section PQ, Week K44, 14 December 1983 Derwent Publications Ltd., London, GB; Class P41, AN 83-806601/44 & SU,A,986 506 (VLADIMIR TRACCOMBN) 7 January 1983 see abstract	1

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9200431 SA 57340

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4221323	09-09-80	None	
GB-A-2181675	29-04-87	FR-A- 2588776	24-04-87
DE-A-1101295		None	
DE-A-1007701		None	

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